Quantitative and spatial analysis of the perturbations at clay/cement interfaces

In disposals of nuclear waste or the storage of CO2 in deep geological formations, concrete will be used to build access structures and drifts as well as vaults and waste packages for Intermediate Level Wastes (ILW). If the host rock is a claystone formation, such as the Callovian-Oxfordian (COx) formation in the eastern part of France, concrete will be in direct contact with the clayey materials. Due to the large geochemical contrasts between concrete (pH ~13) and clays (pH ~7), chemical reactions are expected to induce modifications in both the chemical and physical properties of both the clayey and cement materials. These highly contrasted pH and Eh conditions will lead to ion diffusion. A series of reactions, such as ion exchange on the clay minerals surface, dissolution of some minerals, and precipitations of secondary phases at the interfaces, are likely to occur. In addition, these reactions will change the pore network and therefore the hydraulic properties of both the clay and cement materials.

The combination of different techniques will allow (i) identifying mineralogical changes including the formation of poorly crystallized materials (for example CSH), (ii) the observation of microstructural changes, (iii) quantifying the scale of diffusion processes at the interface, (iv) giving a complete set of data. Such information are necessary to improve understanding of long-term evolution of the materials involved that can be used to either build a comprehensive reactive model or to constrain existing ones.

A multi-scale spatial analysis of in-situ samples experiencing various interaction times will be applied by combining quantitative autoradiograph porosity mapping at sample scale (data already available) and mineral/porosity mapping from electron microprobe chemical maps. The expected spatial balances for both mineral and pore space evolution will provide pivotal constrains for the reactive transport modeling approaches classically used as predictive tools.

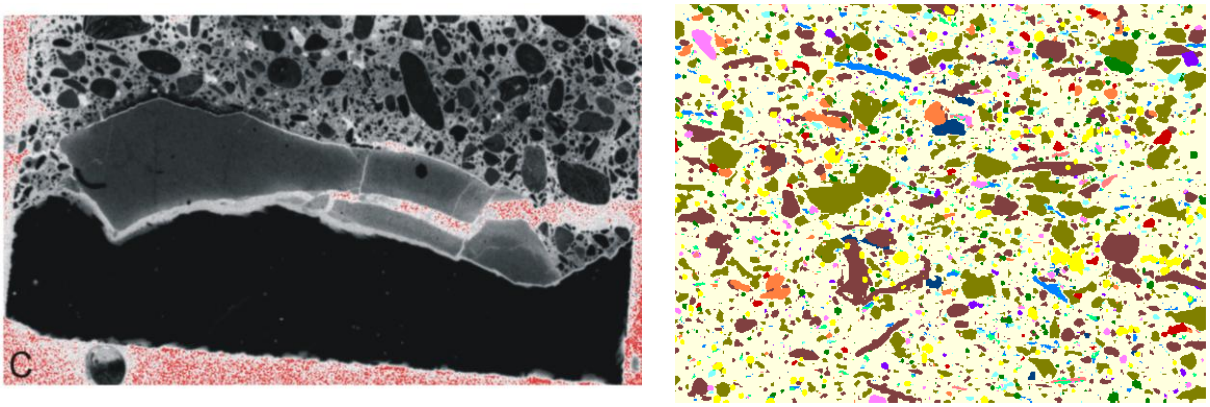

Figure. Autoradiograph porosity mapping (left) of a clay-concrete interface and mineral map of a claystone (right).

Supervisors : Dimitri Prêt (IC2MP Poitiers), Stéphane Gaboreau (BRGM)

Contact : dimitri.pret@univ-poitiers.fr